



June 28, 2017

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**VIA ECFS
& E-MAIL**

Mr. Nicholas Degani, Senior Counsel
Office of FCC Chairman Ajit Pai
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: ET Docket No. 13-49

Dear Mr. Degani:

Thank you for the opportunity to meet and discuss the views of the Association of Global Automakers, Inc. ("Global Automakers") regarding the 5.9 GHz proceeding. In our most recent meeting, you posed a series of questions and sought additional information relevant to consideration of the issues raised in this proceeding. In particular, you asked:

1. Please provide support for the representation that V2V communications could address 89% of light vehicle to light vehicle crashes using four applications.
2. Please provide background on the representation that Society of Automotive Engineers (SAE) standards provide for fifteen safety messages to be communicated over the seven existing DSRC channels.
3. What spectrum is being used for DSRC in other countries and what is the potential for harmonization?
4. How do DSRC proponents benefit commercially from the deployment of V2V service?
5. Which OEMs and suppliers work on and support DSRC activities?



Mr. Nicholas Degani
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Responses to your questions are attached. Should you have additional questions or concerns, please do not hesitate to contact us. We are happy to provide any additional information that may be useful.

Please direct any questions to the undersigned.

Respectfully,

/s/ Scott Delacourt

Scott D. Delacourt
Counsel to Global Automakers

Attachments

cc (via email): Rachael Bender

1. Please provide support for the representation that V2V communications could address 89% of light vehicle to light vehicle crashes using 4 applications.

The NHTSA V2V NPRM discusses four safety applications – Forward Collision Warning, Intersection Movement Assist, Left Turn Assist, and Lane Change Warning – that could eliminate 89% of Light Vehicle to Light Vehicle crashes and 85% of their associated economic costs.¹ Attachment 1 provides the discussion from the NPRM titled, “Overall Crash Population that V2V Could Help Address” and includes references to the detailed technical analyses from which the estimates were derived. See Attachment 1.

2. Please provide background on the representation that Society of Automotive Engineers (SAE) standards provide for fifteen safety messages to be communicated over the seven existing DSRC channels.

The DSRC-based ITS services ecosystem is much more than just a single Basic Safety Message in support of V2V safety. While the DSRC radio and the BSM are the subjects of the current NHTSA NPRM to support light vehicle V2V safety, all channels in the 5.9 GHz band are needed to support a much broader set of safety services.

As discussed in previous filings, the DSRC application channel usage plan has been structured, based on industry consensus, to support an extensive set of safety needs and is currently being finalized at the Society of Automotive Engineers (“SAE”) as follows:

- CH 172: Primarily V2V safety
- CH 174: Primarily V2I safety and mobility
- CH 176: Primarily V2P and security information, such as certificate revocation list (“CRL”) distribution and update
- CH 178: Control channel
- CH 180: Primarily V2V safety, such as cooperative adaptive cruise control (“CACC”) and platooning
- CH 182: Primarily V2I safety, such as work zone speed and road condition advisories
- CH 184: Primarily for high-power, longer-distance public safety

Supporting this channel plan are 15 different types of messages (also part of the SAE standard), which include:

Message Type	Data Provided	Function	Example Applications
Basic Safety Message (BSM)	Speed, direction, turning angle, path history, acceleration/deceleration	Provides data to other nearby vehicles to support crash warning applications	<ul style="list-style-type: none">• Intersection Movement Assist• Left-turn Assist• Forward Collision Warning• Lane Change Warning
Signal Phase and Timing Message (SPAT)	Time to next phase change (i.e., from	Provides data from signalized	<ul style="list-style-type: none">• Red light warning• Speed harmonization

¹ Federal Motor Vehicle Safety Standards; V2V Communications, 82 Fed. Reg. 3854, 3863 (proposed Jan. 12, 2017).

Message Type	Data Provided	Function	Example Applications
	green to yellow, yellow to red)	intersection to approaching vehicles	<ul style="list-style-type: none"> Traffic smoothing
Map Data (MAP)	Road geometry and attributes description such as intersection and lane attributes, freeway ramps, tentative road-change due to construction/roadwork/event, etc.	Provides data to inform the vehicle of road geometries to enable safe driving through intersection, sharp curves, construction zone and other high-risk road segments.	<ul style="list-style-type: none"> Intersection movements Curve speed warning Construction tentative road changes/closures Automated vehicle operation at entrance/exit ramps
RTCM corrections (RTCM)	GNSS correction information	Provides real-time GNSS correction information to improve vehicle localization/positioning, especially in GNSS-challenging environment with limited satellite visibility	All V2X safety applications rely heavily on accurate positioning estimate therefore this is one of the key messages for V2X safety applications.
Personal Safety Message (PSM)	Pedestrian, cyclist, public safety worker and other vulnerable road user's safety information such as type of pedestrian, disability type, road worker type, crossing request.	Increase conspicuousness/visibility of vulnerable road users to approaching vehicles	<p>Pedestrian, cyclist and public safety worker warning.</p> <p>People with disability to communicate to vehicle with special needs such as additional time and space to cross the road</p>
Signal Request Message (SRM)	Preemption/Priority request type for one or more approaching intersections	Request type, vehicle role, importance level, vehicle type, transit vehicle status, occupancy	Emergency and public transit vehicle traffic signal priority/preemption to provide safety and faster mobility
Signal Status Message (SSM)	Requester role, specific lane or approach(s) that the requestor needs to use, and a priority/preemption request response status (whether the request was granted, e.g.)	To inform the signal preemption/priority requester's lane/approach level request detail and the status of whether the request was granted or not, for the requester (emergency vehicles, transit buses, e.g.)	Acknowledgement of signal request response to the requester so that requester entities (emergency vehicles, transit buses, e.g.) can expect the signal behave as requested.
Traveler Information Message (TIM)	Condition advisory or road sign type, location, work zone, speed limit, truck parking, exit service availability, etc.	To inform travelers of road advisories such as road closures, signs and available services	Road advisory, digital traffic signs for human and automated vehicle

Message Type	Data Provided	Function	Example Applications
NMEA corrections (NMEA)	National Marine Electronics Association (NMEA) revision, NMEA message type and the payload specified in NMEA related standards	To provide types of GNSS corrections and other positioning information that is specified in NMEA format	To improve GNSS positioning accuracy
Emergency Vehicle Alert (EVA)	Emergency alert detail, response type, vehicle type and affected vehicle group	To alert nearby vehicle of emergency vehicle presence with specific emergency detail	Emergency vehicle approaching
Probe Data Management (PDM)	Desired probe area, and type of vehicle general and event data to be collected	To request probe vehicles on what data to upload to roadside equipment for probe data use	Probe data request management
Probe Vehicle Data (PVD)	Probe vehicle ID, position, vehicle type, path history, prediction, light status, wiper, ambient air temperature, and many vehicle status data	To report a snapshot of vehicle's traveling status in a predefined distance and/or time segment	Probe data reporting
Road Side Alert (RSA)	Critical road condition based on IT IS codes, priority and affected area	To alert road users of potentially dangerous conditions such as icy bridge, unexpected hazard on road, fire or ambulance in operation, train approaching, etc.	Road safety alert
Common Safety Request (CSR)	Requestor vehicle type, role, request importance, transit vehicle status, occupancy, etc.	Enable unicast in special situation to request specific vehicle information as an add-on to BSM from the requested vehicle	Transit vehicle safety
Intersection Collision Avoidance (ICA)	Vehicle ID, BSM data, path history and prediction, intersection ID, approach and event flag	To alert nearby vehicle of a potentially signal-violating vehicle entering intersection without the right of way. Can be sent from RSE or OBE	Intersection violation alert

Table 1: Message Types

Wave Service Advertisement - In addition, there is a Wave Service Advertisement (WSA) message, which is a generic way for a service provider to let a service user know that a given service is available on a given channel. The idea is to help a service provider and a service user find each other. The service can and usually will be something of public interest, not a commercial service.²

The WSA is part of an overall strategy to allow applications to be mapped flexibly to channels, based on local need. In general, we want to avoid a static mapping between an application and a channel. BSMs are an exception; we want everyone to know where to find them always. PSMs are shaping up to be an exception as well as are others. But, usually a given application could be on channel X in one place/time and Channel Y in another place/time. Combining the flexible application-to-channel mapping with the WSA, a car probably only needs two DSRC radios, one permanently on Ch. 172 for BSMs, and one that switches among service channels and the control channel as services of interest become available. Without WSAs, a car might need 7 radios if it wants to access all types of services.

² Examples of WSA messages include:

- I am an RSU with "Traveler Information" of public interest (e.g., work zone ahead, icy road conditions ahead, stopped vehicle/traffic queue ahead, reduced speed zone, etc.) If you want my information, go to Channel X.
- I can give you RTCM correction data for more precise positioning. I'm broadcasting that information on Channel X
- At a clover leaf there could be an RSU advertising that parties interested in carrying out merge-assist application exchanges should rendezvous on Channel X for the east direction, channel Y for the north direction, Channel Z for the west direction, and Channel W for the south direction (best to split them up on different channels so they don't compete with each other)
- I am a traffic signal controller capable of providing freight signal priority. If you are a truck that wants to request signal priority, go to channel X and we can talk.
- I am an RSU capable of connecting you to the SCMS to renew your security credentials

Channel Mapping - The following chart identifies how the various message types supported the different channels:

	Channels						
	172	174	176	178	180	182	184
SAE Structure	V2V	V2I Safety & Mobility	V2P & Security Info	Control Channel	V2V Safety	V2I Safety	Public Safety
Messages	BSM		PSM	WSA			SSM
	SPAT						SRM
	MAP						
	RTCM (future)						

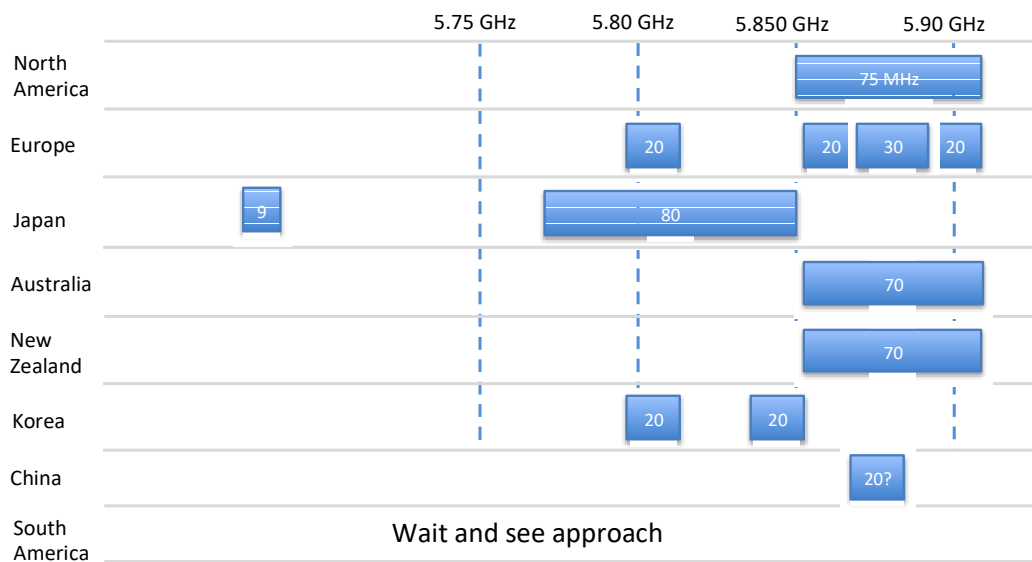
Table 2: Mapping of Messages to Channels

The BSM, PSM, WSA, and SSM/SRM channel allocations are well defined at this point under the current structure. SPAT/MAP/RTCM placements are likely. Other messages not allocated to a specific channel could operate on almost any channel or even multiple channels, depending on the channel usage, status, and priority.

Additional message types to support future innovations that are envisioned but not yet incorporated into the standard include: Cooperative Adaptive Cruise Control, Platooning, and Object Detection. Because DSRC is envisioned as a safety application ecosystem, many additional safety applications and supporting messages will likely be needed in the future.

3. What spectrum is being used for DSRC in other countries?

International DSRC Spectrum Allocation



Country/Region: North America (U.S. and Canada)

Primary focus: Increase safety and efficiency of the nation's surface transportation system

Spectrum being utilized: 5.850 – 5.925 GHz

Discussion: The U.S. has a proposed mandate in process for designating channel 172 (5.855-5.865 GHz) for V2V safety for light vehicles. But this only addresses a piece of the overall need for interference-free low-latency safety and efficiency services. Additional spectrum channels are needed to support currently identified safety services as well as future safety innovations. The current work under SAE is to develop a channel usage plan to support national interoperability.

Country/Region: Europe

Primary focus: Traffic safety, traffic and transport efficiency and a lower rate of emissions

Spectrum being utilized: 5.795-5.815 GHz (tolling); 5.855-5.925 GHz (ITS)

Discussion: The Electronic Communications Committee of the European Conference of Postal and Telecommunications Administrations (CEPT/ECC) has established frequency allocations for the 5.9 GHz band (70MHz) and 63 GHz (2GHz) band according to the following decisions:

- 5855-5875 MHz, ECC recommendation ECC/REC/(08)01, for non-safety ITS applications

- 5875-5905 MHz, EC decision 2008/671/CE and ECC decision ECC/DEC/(08)01, for safety-related ITS application, a.k.a. Cooperative ITS (C-ITS) and vehicle-to-x communications (V2X)
- 5905-5925 MHz, ECC recommendation ECC/DEC/(08)01, as extension band for ITS
- 62-64 GHz, ECC recommendations ECC/DEC/(02)01 and ECC/DEC/(09)01

EU and national projects have shown that the characteristics of the 63 GHz and 5.9 GHz band can complement each other. Therefore, both bands are required for covering the specific ITS related European objectives towards a broad range of services. Furthermore, analyses show that the available capacity in the 5.9 GHz band is not sufficient for future goals of transportation safety and efficiency. Here the additional available bands in 63 GHz will be required in the future.

Country/Region: Japan

Primary focus: Safety & Mobility

Spectrum being utilized: 5.77 – 5.85 GHz for tolling and V2I safety and mobility services; 755.5-764.5 MHz under consideration to support V2V safety.

Discussion: Through its ITS Spot V2I initiative, using 5.8 GHz, Japan uses roadside devices located along expressways to simultaneously collect data from vehicles to allow traffic managers to identify congestion, while also providing information to drivers regarding upcoming congestion and alternative routes. Japan has over 23 million toll collection devices in the 5.8 GHz band. Japan's Association of Radio Industries and Businesses (ARIB) is studying using this band, as well as 700 MHz band, for V2V. ARIB's standards are significantly different than U.S. and EU standards.

Country/Region: Australia

Primary focus: Priority on road safety as well as reducing the environmental impact of increased road use and congestion.

Spectrum being utilized: 5.855 – 5.925 GHz (proposed?)

Discussion: C-ITS technologies use dedicated short-range communications (DSRC) to transfer data over short distances between in-vehicle mobile radio units and roadside units, and can be used for a wide range of applications, such as monitoring and managing traffic flow, relieving traffic congestion, providing alternative routes to travelers and reducing the environmental impacts of transport. The transmission of real-time information between vehicles, or between vehicles and road network operators, has the potential to improve road safety, reduce the number of crashes and save lives.

Country/Region: Korea

Primary focus: V2V and V2I Safety

Spectrum being utilized: 5.795 – 5.825 (tolling); 5.835 – 5.855 GHz (ITS)

Discussion: Safety-of-life and public safety including: Vehicle crash prevention, road environment safety, intersection safety, public transit safety support, vulnerable road users, and inter-vehicle safety messages.

Country/Region: China

Primary focus: V2V and V2I applications

Spectrum being utilized: The Chinese "FCC" ministry has approved 5.905-5.925 MHz for V2V and V-I testing, through 12/31/2017.

Discussion: It is for LTE-V and is open for DSRC as well. The country has not made final decision yet on which technology to use.

Country/Region: New Zealand

Primary focus: TBD

Spectrum being utilized: 5.855 – 5.925 GHz (proposed)

Discussion: TBD

4. How will DSRC proponents benefit commercially from the deployment of V2V service?

The deployment of DSRC technology is first and foremost to address safety. There are significant safety benefits that can be achieved through the widespread deployment of the technology.

To achieve the maximum safety benefit, and provide opportunities for innovation and competitive differentiation, automakers have been working collaboratively to establish communication data interoperability standards. The technology is designed to provide significant opportunities for manufacturers and technology developers to innovate and expand upon the available safety applications that can leverage V2V communications. To fully realize the benefits however, it is important to achieve a network effect. Global Automakers is therefore supportive of the NHTSA Federal Motor Vehicle Safety Standard (FMVSS) to establish the necessary standards to support a nationwide network more quickly across the vehicle fleet.

As the network expands over time it will enable and support the launch of new applications, and manufacturers and developers will be able to competitively differentiate by providing a range of communications-based safety technologies and applications to their customers. The focus of the NHTSA NPRM is limited to establishing the communications technology/network and ensuring interoperability. Development and deployment of safety applications will be driven by market forces, just as OEMs today differentiate themselves by making a variety of innovative safety features available to consumers.

5. Which OEMs and suppliers are working on and support DSRC activities?

Global Automakers' members are strongly supportive of DSRC. However, automakers are just one part of the greater DSRC/5.9 GHz ecosystem that involves heavy trucks, transit vehicles, technology companies, and suppliers. In addition, there is significant interest on the part of transportation infrastructure owners and operators to deploy DSRC technology in support of V2I safety and mobility applications. The following provides a listing of a number of companies and organizations that we believe are generally supportive of DSRC based on their comments submitted on the NHTSA proposed V2V rule:

- American Automobile Association
- AASHTO
- American Trucking Associations
- Alliance of Automobile Manufacturers
- Automotive Safety Council
- Autotalks

- Bosch
- Car 2 Car Communication Consortium
- Cisco
- Continental
- DanLaw
- Delphi
- Denso
- EMA
- FICOSA
- Global Automakers
- GM
- IIHS
- Honda
- Illinois Tollway
- ITS America
- Laird
- Law Office of Stephen E. Selander
- MEMA
- National Safety Council NTSB
- Panasonic
- Peloton
- Subaru
- Texas DOT
- Toyota
- Virginia DOT

ATTACHMENT 1

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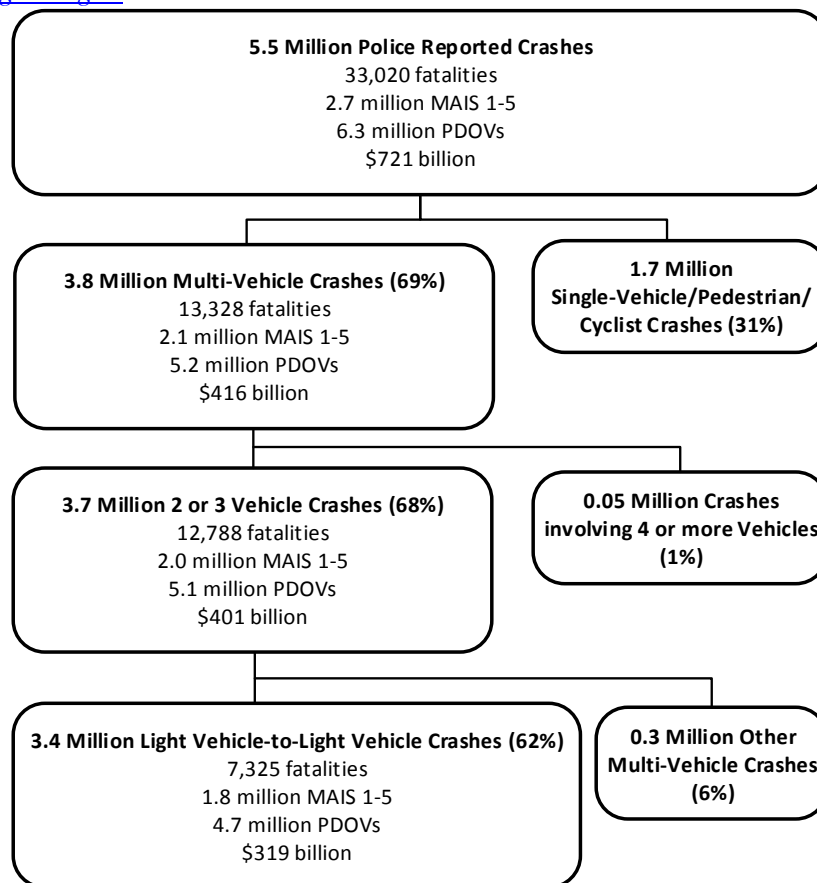


Figure II-1 Crash Population Breakdown for V2V Technology

2. Pre-Crash Scenarios Potentially Addressed by V2V Communications

In a separate analysis that has been updated using an average of 2010 through 2013 General Estimate System data (which does not include FARS data), the agency started with the initial 37 pre-crash scenarios that have been defined based on police-reported crashes from previous analyses for all crashes.¹⁵ Of the 37 scenarios, 17 were deemed potentially addressable

¹⁵ Najm, W.G., R. Ranganathan, G. Srinivasan, J. Smith, S. Toma, E. Swanson, and A. Burgett, "Description of Light Vehicle Pre-Crash Scenarios for Safety Applications Based on Vehicle-to-Vehicle Communications." DOT HS 811 731, U.S. Department of Transportation, National Highway Traffic Safety Administration, May 2013. <http://www.nhtsa.gov/Research/Crash-Avoidance/Vehicle%E2%80%93to%E2%80%93Vehicle-Communications-for-Safety> (last accessed Dec 8, 2016)

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by V2V communications. Further statistical analysis focusing on the frequency and severity of those 17 pre-crash scenarios identified the top 10 (priority) pre-crash scenarios that V2V could potentially address. Table II-1 provides a graphical depiction of the flow of the pre-crash scenario breakdown used in the analysis.

Table II-1 37 Pre-Crash Scenario Typology

1	Vehicle Failure	21	Vehicle(s) Not Making a Maneuver – Opposite Direction
2	Control Loss with Prior Vehicle Action	22	Following Vehicle Making a Maneuver
3	Control Loss without Prior Vehicle Action	23	Lead Vehicle Accelerating
4	Running Red Light	24	Lead Vehicle Moving at Lower Constant Speed
5	Running Stop Sign	25	Lead Vehicle Decelerating
6	Road Edge Departure with Prior Vehicle Maneuver	26	Lead Vehicle Stopped
7	Road Edge Departure without Prior Vehicle Maneuver	27	Left Turn Across Path from Opposite Directions at Signalized Junctions
8	Road Edge Departure While Backing Up	28	Vehicle Turning Right at Signalized Junctions
9	Animal Crash with Prior Vehicle Maneuver	29	Left Turn Across Path from Opposite Directions at Non-Signalized Junctions
10	Animal Crash without Prior Vehicle Maneuver	30	Straight Crossing Paths at Non-Signalized Junctions
11	Pedestrian Crash with Prior Vehicle Maneuver	31	Vehicle(s) Turning at Non-Signalized Junctions
12	Pedestrian Crash without Prior Vehicle Maneuver	32	Evasive Action with Prior Vehicle Maneuver
13	Pedalcyclist Crash with Prior Vehicle Maneuver	33	Evasive Action without Prior Vehicle Maneuver
14	Pedalcyclist Crash without Prior Vehicle Maneuver	34	Non-Collision Incident
15	Backing Up into Another Vehicle	35	Object Crash with Prior Vehicle Maneuver
16	Vehicle(s) Turning – Same Direction	36	Object Crash without Prior Vehicle Maneuver
17	Vehicle(s) Parking – Same Direction	37	Other
18	Vehicle(s) Changing Lanes – Same Direction		

see also Najm, W.G., J. Smith, and M. Yanagisawa, “*Pre-Crash Scenario Typology for Crash Avoidance Research.*” DOT HS 810 767, U.S. Department of Transportation, National Highway Traffic Safety Administration, April 2007. Najm, W.G., B. Sen, J.D. Smith, and B.N. Campbell, “*Analysis of Light Vehicle Crashes and Pre-Crash Scenarios Based on the 2000 General Estimates System.*” DOT HS 809 573, U.S. Department of Transportation, National Highway Traffic Safety Administration, November 2002. Available at <http://www.nhtsa.gov/Research/Crash-Avoidance/Vehicle%E2%80%93to%E2%80%93Vehicle-Communications-for-Safety> (last accessed Dec 8, 2016).

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19	Vehicle(s) Drifting – Same Direction		
20	Vehicle(s) Making a Maneuver – Opposite Direction		

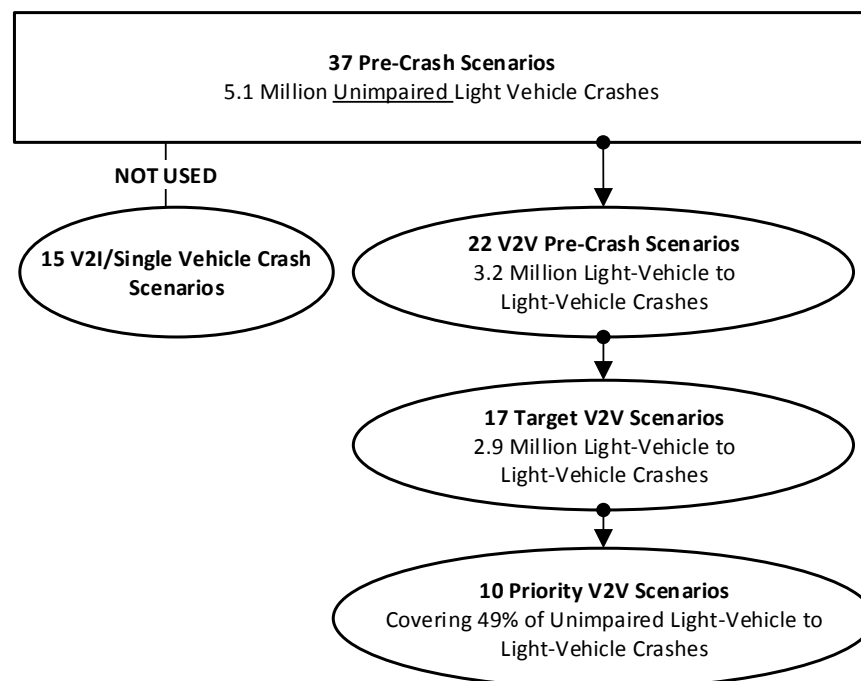


Figure II-2 V2V Pre-Crash Scenario Breakdown¹⁶

The 10 priority pre-crash scenarios listed in Table II-2 can be addressed by the corresponding V2V-based safety applications.

Table II-2 Pre-Crash Scenario/Safety Application Association

Pre-Crash Scenarios	Pre-crash Groups	Associated Safety Application
Lead Vehicle Stopped	Rear-end	Forward Collision Warning
Lead Vehicle Moving	Rear-end	Forward Collision Warning
Lead Vehicle Decelerating	Rear-end	Forward Collision Warning/Emergency Electronic Brake Light
Straight Crossing Path @ Non Signal	Junction Crossing	Intersection Movement Assist
Left-Turn Across Path/Opposite Direction	Left Turn @ crossing	Left Turn Assist

¹⁶ Average of 2010-2013- GES data;* Includes only 2&3 vehicle crashes; **Includes running red-light and running stop sign

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Opposite Direction/No Maneuver	Opposite Direction	Do Not Pass Warning
Opposite Direction/Maneuver	Opposite Direction	Do Not Pass Warning
Change Lanes/Same Direction	Lane Change	Blind Spot/Lane Change Warning
Turning/Same Direction	Lane Change	Blind Spot/Lane Change Warning
Drifting/Same Direction	Lane Change	Blind Spot/Lane Change Warning

The six applications listed in Table II-2 were developed and tested in the Connected Vehicle Safety Pilot Model Deployment.¹⁷ These safety warning applications were (1) Forward Collision Warning (FCW), (2) Emergency Brake Light (EEBL), (3) Intersection Move Assist (IMA), (4) Left Turn Assist (LTA), (5) Do Not Pass Warning (DNPW), and (6) Blind Spot/Lane Change Warning (BS/LCW). A description of each safety application and relationship to the pre-crash scenarios is provided below.

(1) Forward Collision Warning (FCW): warns drivers of stopped, slowing, or slower vehicles ahead. FCW addresses rear-end crashes that are separated into three key scenarios based on the movement of lead vehicles: lead-vehicle stopped (LVS), lead-vehicle moving at slower constant speed (LVM), and lead-vehicle decelerating (LVD).

(2) Emergency Electronic Brake Light (EEBL): warns drivers of heavy braking ahead in the traffic queue. EEBL would enable vehicles to broadcast its emergency brake and allow the surrounding vehicles' applications to determine the relevance of the emergency brake event and alert the drivers. EEBL is expected to be particularly useful when the driver's visibility is limited or obstructed.

(3) Intersection Movement Assist (IMA): warns drivers of vehicles approaching from a lateral direction at an intersection. IMA is designed to avoid intersection crossing crashes, the most severe crashes based on the fatality counts. Intersection crashes include intersection, intersection-related, driveway/alley, and driveway access related crashes. IMA crashes are categorized into two major scenarios: turn-into path into same direction or opposite direction and straight crossing paths. IMA could potentially address five of the pre-crash scenarios identified in Table II-2.

¹⁷ The Connected Vehicle Safety Pilot ("Safety Pilot") Program was a scientific research initiative that features a real-world implementation of connected vehicle safety technologies, applications, and systems using everyday drivers. The effort will test performance, evaluate human factors and usability, observe policies and processes, and collect empirical data to present a more accurate, detailed understanding of the potential safety benefits of these technologies. The Safety Pilot program includes two critical test efforts—the Safety Pilot Driver Clinics and the Safety Pilot Model Deployment. See http://www.its.dot.gov/research_archives/safety/cv_safetypilot.htm for more information. (last accessed Dec 7, 2016).

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(4) Left Turn Assist (LTA): warns drivers to the presence of oncoming, opposite-direction traffic when attempting a left turn. LTA addresses crashes where one involved vehicle was making a left turn at the intersection and the other vehicle was traveling straight from the opposite direction.

(5) Do Not Pass Warning (DNPW): warns a driver of an oncoming, opposite-direction vehicle when attempting to pass a slower vehicle on an undivided two-lane roadway. DNPW would assist drivers to avoid opposite-direction crashes that result from passing maneuvers. These crashes include head-on, forward impact, and angle sideswipe crashes.

(6) Blind Spot/Lane Change Warning (BS/LCW): alerts drivers to the presence of vehicles approaching or in their blind spot in the adjacent lane. BS/LCW addresses crashes where a vehicle made a lane changing/merging maneuver prior to the crashes.

The final table, Table II-3, merges the estimated target crash population for LV2LV crashes detailed in Table II-2 with the separate analysis that provided the breakdown of V2V pre-crash scenarios and relationships to prototype V2V safety applications. The 3.4 million LV2LV are distributed among the pre-crash scenarios that are associated with V2V safety applications and the economic and comprehensive costs. More specifically, Table II-3 provides a breakdown of crashes associated with FCW, IMA, LTA, and LCW scenarios that are used later when discussing potential benefits in Section VII. Crash scenarios associated with DNPW and EEBL are grouped with all remaining crashes under the "other" category due to the fact they are not used when discussing benefits. The agency grouped these two potential applications into the "other" category because of EEBL's advisory nature that cannot be directly attributed to avoiding a specific crash and the agency's current understanding of DNPW indicates it only addresses a limited amount of crashes per a specific situation and where there are three equipped vehicles present, limiting the amount of information available to develop comprehensive effectiveness estimates.

Overall the agency estimates that, together, these four potential safety applications that could be enabled by this proposal could potentially address nearly 89 percent of LV2LV crashes and 85 percent of their associated economic costs.

Table II-3 Crash Scenarios for LV2LV Safety Population

V2V Safety Applications -Crashes	Crash Scenarios	Crashes	MAIS 1-5 Injuries	Fatalities	PDOVs	Economic Costs (Billion)	Comprehensive Costs (Billion)
FCW Rear-End Crashes	Lead Vehicle Stopped	998,664	497,907	242	68,508	\$27.4	\$65.7
	Lead Vehicle Moving	146,247	80,508	242	12,605	\$4.6	\$12.9
	Lead Vehicle Decelerating	343,183	173,538	78	25,599	\$9.5	\$23.1
	Total	1,488,094	751,953	562	106,712	\$41.5	\$101.6
IMA Intersection	Turn-Into Path, Into	425,145	218,852	472	48,423	\$12.6	\$34.8

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Crossing Crashes	Same Direction or Opposite Direction						
	Straight Cross Path	346,187	251,488	1,399	66,580	\$14.4	\$49.4
	Total	771,332	470,340	1,871	115,003	\$26.9	\$84.3
LTA Left-Turning Crashes	Turn Across Path, Initial Opposite Direction	298,542	224,336	613	64,233	\$11.7	\$37.9
BS/LCW Lane Change/Merge Crashes	Vehicle Changing Lane, Same Direction	475,097	175,044	397	20,816	\$11.4	\$26.6
Others	Others	378,659	192,152	3,882	4,416,890	\$16.7	\$66.4
Total	Total	3,411,724	1,813,825	7,325	4,723,654	\$108.2	\$316.8

Note: due to rounding, the total might not be equal to the sum of each component

B. Ways to address the Safety Need

The most effective way to reduce or eliminate the property damage, injuries, and fatalities that occur annually from motor vehicle crashes is to lessen the severity of those crashes, or prevent those crashes from ever occurring. In recent years, vehicle manufacturers have begun to offer, or have announced plans to offer, various types of crash avoidance technologies that are designed to do just that. These technologies are designed to address a variety of crashes, including rear end, lane change, and intersection.

1. Radar and camera based systems

Many of the advanced crash avoidance technologies currently available in the marketplace employ on-board sensor technologies such as cameras, RADAR, or LIDAR, to monitor the vehicles' surroundings.¹⁸ These technologies are what we call "vehicle-resident" systems because they are systems installed on one vehicle and, unlike V2V, do not communicate with other vehicles. Cameras, RADAR, and LIDAR that are installed on the vehicle can gather information directly by sensing their surroundings, and vehicle-resident crash avoidance technologies can use that information to warn the driver of impending danger so the driver can take appropriate action to avoid or mitigate a crash. Crash scenarios that can currently be addressed by existing crash avoidance technologies include, but are not limited to, Forward Collision Warning (FCW),¹⁹ Blind Spot Warning (BSW), and Lane Change Warning (LCW).²⁰

¹⁸ A LIDAR device detects distant objects and determines their position, velocity, or other characteristics by analysis of pulsed laser light reflected from their surfaces. Lidar operates on the same principles as radar and sonar.

¹⁹ FCW warns the driver of an impending rear-end collision with a vehicle ahead in traffic in the same lane and direction of travel.